UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 46 TO FACILITY OPERATING LICENSE NO. NPF-1

PORTLAND GENERAL ELECTRIC COMPANY

THE CITY OF EUGENE, OREGON

PACIFIC POWER AND LIGHT COMPANY

TROJAN NUCLEAR PLANT

DOCKET NO. 50-344

Introduction

By letter dated January 5, 1979, Portland General Electric Company, et al., requested changes to the Technical Specifications (TS) for operation of the Trojan Nuclear Plant in Columbia County, Oregon. The proposed changes relate to the use of the Westinghouse Improved Thermal Design Procedure and the WRB-1 Critical Heat Flux Correlation. Both relate to methods and procedures for determining safety limits and reactor protection system settings for protection from departure from nucleate boiling (DNB) in the reactor core.

Discussion and Evaluation

One of the safety limits which must be met by every operating PWR is based on the requirement that the fuel rods must not experience DNB during Condition 1 (normal operation) and Condition 2 (moderate frequency) events. This safety limit is expressed as a DNB Ratio. When the Trojan reactor was licensed, the method used to calculate the DNB Ratio was based on the Westinghouse method existing at that time (Reference 1). Since that time, Westinghouse has proposed (Reference 2), and the staff has approved (Reference 3), a new method of calculating the DNB Ratio for Condition 1 and Condition 2 events. It is this new method that Portland General Electric (PGE, the licensee) has proposed to use for the Trojan reactor.

In the original method the accident analysis is done with conservative values (resulting in low DNB Ratios) assigned to the significant variables (such as power, power distribution, reactor coolant system pressure, coolant flow, etc.). This method implies that the values of these input variables will be at their most conservative values simultaneously. The conservative values are determined by adding or subtracting the appropriate uncertainty in the variable to/from its nominal value.

In the Improved Thermal Design Procedure the safety analysis is performed with these same variables at their nominal values. A new DNB Ratio safety limit is defined which includes the uncertainties in these variables. The details of this procedure are described in Reference 3.

In addition to these differences in the method of including uncertainties in the calculation of the DNB Ratio, the Improved Thermal Design Procedure employs a different criterion for the safety limit. The fixed-value method used a safety limit which met the following criterion as stated in the Trojan FSAR:

> DNB will not occur on at least 95% of the limiting fuel rods during normal operation and operational transients and any conditions arising from faults of moderate frequency at a 95% confidence level (Section 4.4.1.1).

This criterion was met with the W-3 Critical Heat Flux (CHF) correlation with appropriate multipliers which gives a DNB Ratio safety limit of less than the traditional value of 1.3. However, the licensee has used the 1.3 value.

The Improved Thermal Design Procedure uses the following criterion (from Reference 2):

> Considering plant parameter uncertainties, there must be at least a 95% probability that the minimum DNB Ratio of the limiting power rod during Condition 1 and 2 events is greater than or equal to the DNB Ratio limit of the DNB correlation being used. The DNB Ratio limit for the correlation is established based on the variance of the correlation such that there is a 95% probability with 95% confidence that DNB will not occur when the calculated DNB Ratio is at the DNB Ratio limit.

The significance of the change in the safety limit criterion is shown in Figure 1 (taken from Reference 3). While the fixed value method used the 1.30 value (with the W-3 correlation) as a limit, the Improved Thermal Design Procedure allows this limit to be exceeded with a 5% probability. The difference is subtle but significant. While the fixed value method establishes a safety limit which gives a 95% probability the DNB will not occur with a 95% confidence, the limit of the Improved Thermal Design Procedure gives a 95% probability that the safety limit of the fixed value method will not be exceeded with a 95% confidence. The limit of the Improved Thermal Design Procedure is called the design limit.

In addition to the use of the Improved Thermal Design Procedure, the licensee also employed a new DNB correlation called WRB-1. The derivation and description of this correlation is given in Reference 4. The staff Safety Evaluation Report approving use of this correlation is given in Reference 5. The value of the safety limit for this correlation is 1.17. This value meets the criterion for a DNB safety limit as stated in the Trojan FSAR given previously.

The value of the design limit determined for Trojan by the Improved Thermal Design Procedure with the WRB-1 correlation is 1.36 for thimble coldwall cells (three fuel rods and a guide tube) and 1.38 for typical cells (four fuel rods) without consideration of fuel rod bowing. In addition, the design limit has been conservatively increased by the licensee to incorporate an arbitrary 20.2% margin in DNB Ratio. The design DNB Ratio values which include the 20.2% DNB Ratio margin are 1.71 and 1.73 for thimble wall and typical cells, respectively. These design limits were used in the accident analysis and set point determinations.

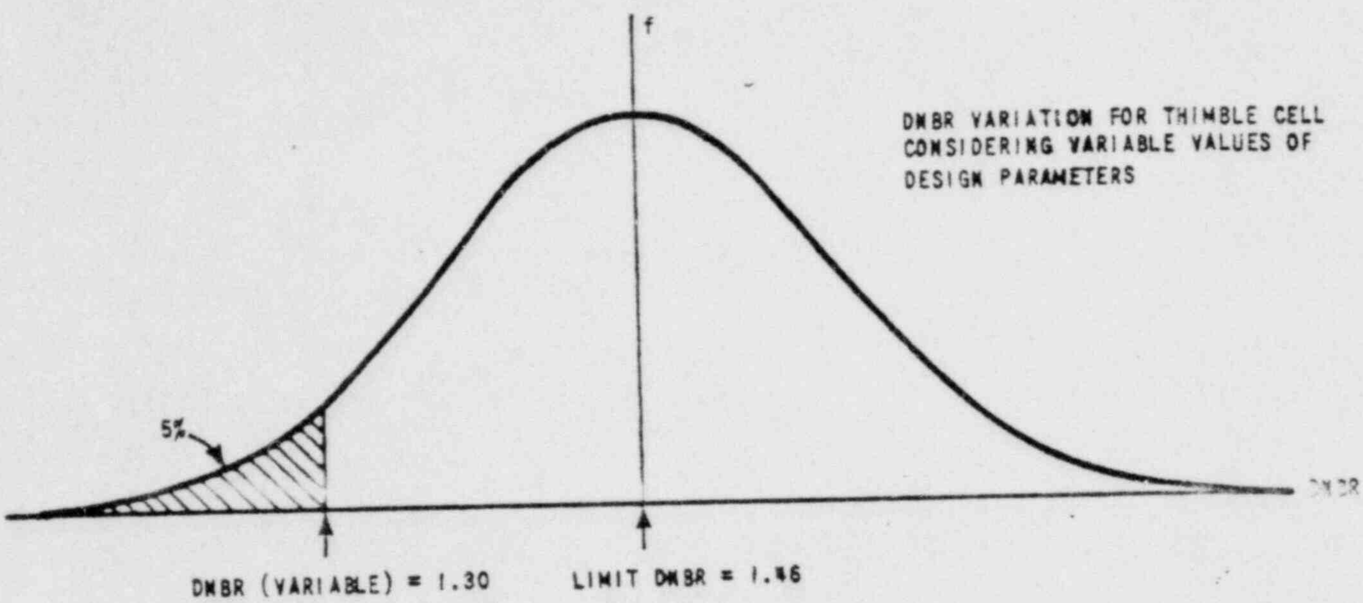

Figure 1 Interpretation of DNB Ratio Safety Limit With The Improved Thermal Design Procedure

The staff Safety Evaluation Report on the Improved Thermal Design Procedure (Reference 5) states several requirements which must be met in order to use the new procedure. The first requirement is that all Condition 1 and Condition 2 events which must meet the DNB Ratio safety limit should be reanalyzed to show that they satisfy the design limit of the Improved Thermal Design Procedure. The second requirement is that the uncertainties assumed in determining the design limit must be consistent with the instrumentation and design of the particular reactor. The licensee's submittal (Reference 2) meets the first requirement. All Condition 1 and 2 events listed in Table 3 of the staff Safety Evaluation Report have either been reanalyzed or are bounded by some other analysis.

The second requirement concerning applicability of the uncertainties used in the analysis was discussed in detail by the licensee in Reference 6.

In particular, the licensee provided in Reference 6 a description of sensors, process equipment, computer and readout devices for pressure, reactor coolant flow, reactor power and reactor coolant temperatures. For each element, the accuracy, drift and range were given. The standard deviation for each measurement was determined by summing the variances of each component to obtain the total system variance. The standard deviation is the square root of the variance. These standard deviations were compared with the corresponding values used in the analysis. The analysis values were bounding.

The staff, with our consultants at Idaho Nuclear Engineering Laboratory (INEL), reviewed Reference 6. We agree with the licensee's analysis of the design accuracy of the pressure, temperature, power, and flow measuring systems used at the Trojan Nuclear Plant.

We also reviewed the frequency and methods of surveillance used by the licensee to assure that the values he stated for his instrumentation would actually be met.

The TS require periodic checks of pressure, temperature, power, and flow instruments to ensure proper operation. A functional channel check done monthly on each of these instruments verifies instrument performance by the injection of a signal into the circuitry to ensure operability including alarm and trip initiation features.

The licensee submitted data based on operating history to demonstrate a high degree of confidence that the required instruments would perform within their design accuracies. While data on reactor coolant flow instrumentation was not included, data on temperature, pressure, and power shows that only one out-of-limits condition occurred over a 39-month period which included 504 functional channel checks of these instruments. This data represents a success rate of 99.8%.

The licensee also submitted data on several instruments showing calibration data. These data indicate that the design accuracies submitted by the licensee are reasonable based on the actual calibration tests.

Based on the design instrument accuracies provided by the licensee, the pressurizer pressure, average temperature, reactor power, and reactor coolant flow instrument accuracies are within the limits assumed by the Improved Thermal Design Procedure for preventing a DNB occurrence. Data provided on instrument performance and the requirements of the TS indicate that adequate measures exist at the Trojan Nuclear Plant to monitor these instruments and to ensure the instruments will perform with a high degree of confidence within their design accuracies.

Based on the data on instrument performance provided by the licensee and the requirements of the TS, adequate measures exist at the Trojan Nuclear Plant to monitor the required instrumentation to ensure continued operation within the limits specified in the safety analysis.

The licensee has provided adequate analyses to show that the core is protected from DNB for all Condition 1 and Condition 2 events.

For the above reasons the application of the Westinghouse Improved Thermal Design Procedure in conjunction with the WRB-1 correlation is acceptable.

Environmental Consideration

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: July 25, 1980

References

1. Final Safety Analysis Report, Trojan Nuclear Plant, Section 4.4.

2. Letter from C. Goodwin, PGE, to A. Schwencer, USNRC, License Change Application 49, January 5, 1979.

3. Chelemer, H., et. al, "Improved Thermal Design Proceuure", Westinghouse Electric Corporation, WCAP 8567, July 1975.

4. Motley, F., et. al, "New Westinghouse Correlation WRB-1 For Predicting Critical Heat Flux in Rod Bundles With Mixing Vane Grids", Westinghouse Electric Corporation, WCAP 8762, July 1976.

5. Letter from J. F. Stolz, USNRC, to C. Eicheldinger, Westinghouse Electric Corporation, April 19, 1978.

6. Letter from C. Goodwin, PGE, to A. Schwencer, USNRC, "Additional Information Required for Trojan to Justify Use of Improved Thermal Design Procedure", November 5, 1979.